海洋潮汐がトリガーとなる氷河地震

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Ocean tide triggers glacial earthquakes

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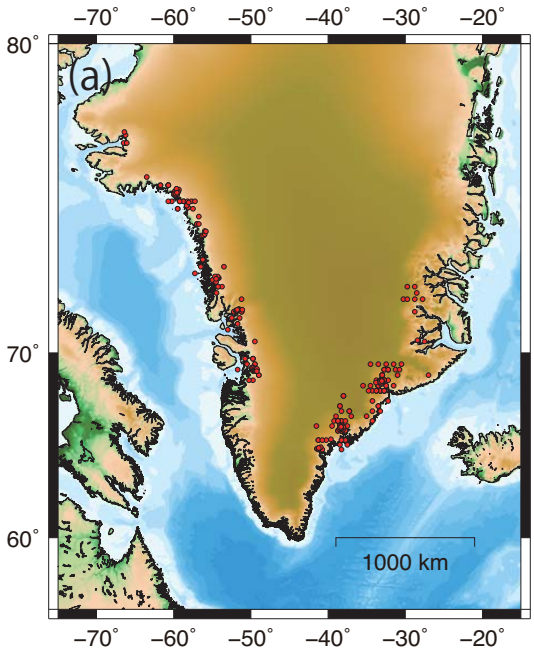
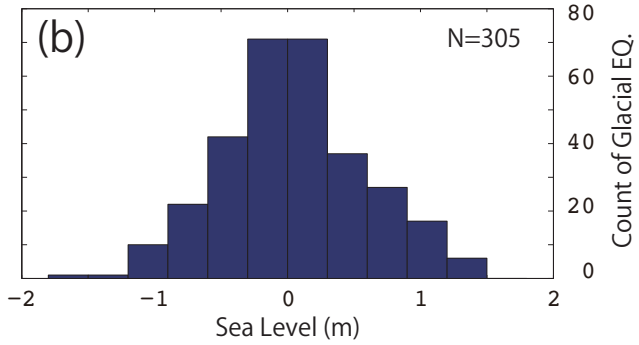
Understanding the dynamics of glacial earthquakes within major outlet glaciers in polar regions is of importance to study the mechanisms of the glacial discharge to the ocean. Their temporal variations including the periodicity of the event occurrence provide important information on the dynamics and effects of external forces acting the glacial earthquakes. Since the glacial earthquakes locate near the ends of the outlet glaciers, we hypothesize that the height variation of sea surface should affect the occurrence of glacial earthquakes. When the sea surface rise, the buoyancy increases to lift a glacier and the seawater penetrates into the boundary between the glacier bottom and the basement rock. These phenomena would accelerate the glacier flow and then the occurrence of the glacial earthquakes. We investigate the correlation between the event occurrence and the ocean tide. Figure 1 shows the event frequency as a function of the tidal height for reported events in Greenland (Tsai and Ekstrom 2007, Veitch and Nettles 2012). Although the histogram is drawn with ignoring the regional difference of the tidal amplitudes, it is found that the events have a tendency to occur in periods of high tides near the glaciers. Analyses of the individual glaciers reveal more clear correlations between the frequency of the glacial earthquakes and the tidal heights.

極域の氷河末端部でみられる氷河地震の発生機構を知ることは氷河流出のダイナミクスを知る上でも重要である。氷河地震の発生頻度の周期性は、氷河地震を起こす外力や氷河流出のダイナミクスを調べるのに、重要な情報の一つである。氷河地震は海に流れ込む氷河末端部で多く発生しているので、海面の高度変化に影響を受けると考えられる。我々は、氷河地震の発生機構の一つとして、海面が上昇することにより氷河末端部では浮力が働き、さらに氷河底面と岩石基盤の間に水が侵入することで、氷河地震が発生すると仮説を立てて、検証を行った。そこでこれまで報告されたグリーンランドでの氷河地震（Tsai and Ekstrom 2007, Veitch and Nettles 2012）とその近傍での海洋潮汐の高さとの相関を調べた。Figure 1に示したのは、全地震について潮汐の振幅と氷河地震発生頻度をまとめたものである。相関は弱いながらも、海面の上昇期に氷河地震の発生頻度がやや高い。個々の氷河でみると、潮汐の振幅が高いグリーンランド南部の氷河では、こうした傾向がより強いことがわかった.





(c)

	Sea Level (cm)				
	0-30	30-60	60-90	90-120	120-
Count of EQ (Positive Height)	71	37	27	17	6
Count of EQ (Negative Height)	71	42	22	10	2
Ratio ($\frac{\text{Positive}}{\text{Negative}}$)	1	0.9	1.2	1.7	3

Figure 1. Correlation between the glacial earthquakes and the ocean tide. (a) Distribution of the glacial earthquakes. Red dots shows the epicenters of glacial earthquakes in Greenland (Tsai and Ekstrom,2007; Veitch and Nettles ,2012).(b) Histogram of glacial earthquake against sea level. (c) Relationship between sea level and number of the glacial earthquakes.

References

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